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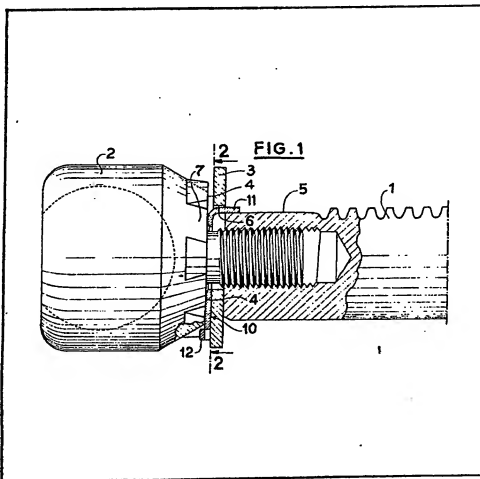
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**(54) Lock Washer and Assembly  
Including said Washer**

(57) A lock washer 10, between two members (1, 2) which are assembled by means of a screwthread, comprises a bent tab 11, which projects from one of the faces of the washer and co-operates with a flat face 5 provided on one of the members 1, and a plurality of tongue portions 12 which extend circumferentially and co-operate with

recesses 7 formed in the other member 2. The tab 11 may be on the outer periphery of the washer 10 but preferably extends from the centre orifice, in which case the circumferential tongue portions are arranged on the whole of the periphery of the washer; e.g. Fig. 5, and preferably are formed on a conical surface. A thrust washer 3 has a non-circular hole 6, or a second hole, to receive the tab 11.



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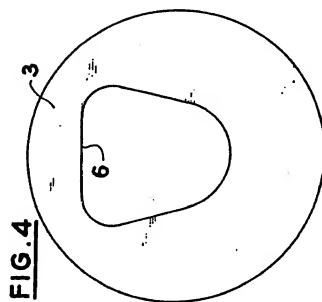
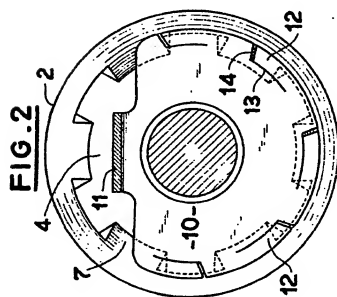
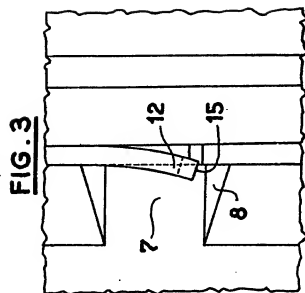
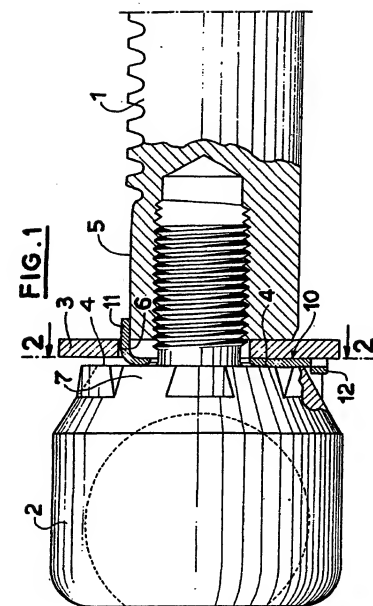


FIG. 5

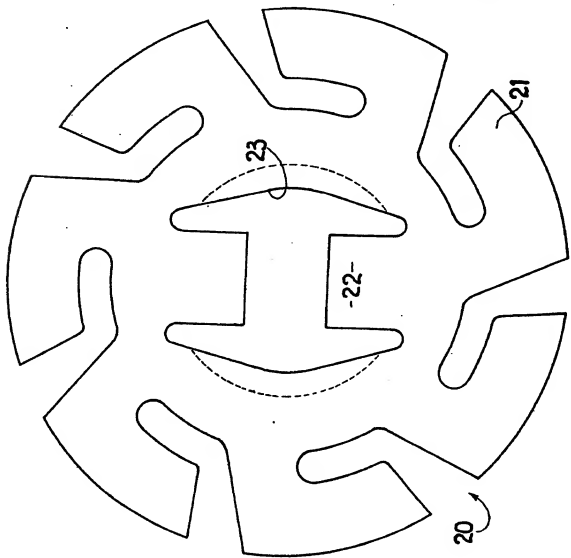


FIG. 6

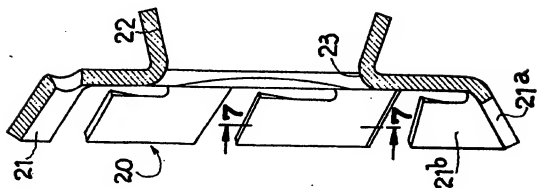


FIG. 7

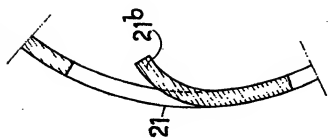


FIG. 8

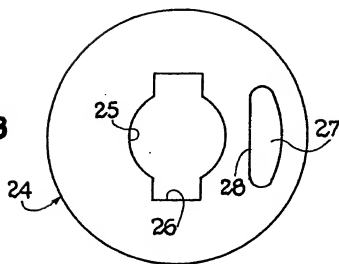
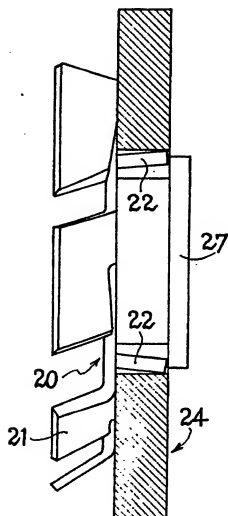


FIG. 9



## SPECIFICATION

## Lock Washer and Assembly Including Said Washer

The present invention relates to a lock or stop washer and an assembly including this washer. It is known that lock washers are employed for preventing the relative untightening of two assembled parts. Some of these washers are made from sheet steel and are curved so as to have a part-conical or corrugated shape and the stopping action is achieved by the effect of friction. However, such washers do not provide a positive lock or stop between the two parts and are therefore not very reliable. Other washers made from mild steel sheet comprise tongue portions which must be bent manually, after the screwing, onto the two parts to be assembled. These washers also have serious drawbacks since the tongue portions forming the locking means must be bent over carefully by hand. Moreover, the clamping force is liable to decrease since the mild steel washers become compressed. Lastly, a recess must be provided around the assembled parts in order to effect the locking in a correct manner.

Lock or stop washers are also known which comprise teeth which project from both sides of the washers and are produced by cutting out the metal and twisting radially extending tongue portions. The teeth projecting from one side cooperate with recesses formed in the adjacent face of one of the parts to be assembled. The stopping action relative to the other part is achieved by friction, which provides a more or less efficient holding action depending on the hardness of the materials. This arrangement does not allow passing through an intermediate element to thus achieve an assembly of three elements. Further, the stopping teeth are obtained by deformation of radially extending tongue portions and the latter are subjected to bending stress which is disadvantageous.

In another known arrangement (French patents No. 1,394,517 and 483,904), the tongue portions are cut from the washer and project from one side thereof, at least one of these tongue portions being in contact by its inner edge and with a side of the adjacent nut. With such an arrangement, any tendency to untighten is manifested by a bending of the tongue portion which is engaged with the nut and the maximum untightening torque is low. Moreover, the stopping action can only be achieved relative to a part having flat faces.

It is also known from French patent No. 748,592 to employ a washer which is split throughout its radial extent, one of the free edges of which projects from one side and cooperates with notches provided in the adjacent face of one of the parts to be assembled, for example a nut. In this case, there is only a single retaining line or surface, which does not provide a good precision for the locking position. Moreover, the washer is completely split and this constitutes

65 another drawback.

An object of the invention is to provide a locking or stopping device between two parts assembled by means of a screwthreaded connection, of the type comprising a washer interposed between the two parts and comprising means for providing a stopping action relative to the two adjacent parts, which does not have the drawbacks of known arrangements and which, in particular, is easily placed in position and provides an efficient positive stopping action relative to the two parts of the assembly while allowing a precise adjustment of the locked position of the two parts.

According to the invention, there is provided a lock washer comprising tongue portions a part of which projects from at least one face of the washer, wherein the projecting parts on one face are defined by the free ends of a plurality of circumferential tongue portions which extend progressively away from the plane of the washer.

In a known manner, there is also provided at least one tab which is bent at roughly a right angle and projects from the other face of said washer.

According to other features: the or each bent tab extends from the edge of the centre orifice of the washer;

the circumferential tongue portions are arranged on the whole of the periphery of the washer;

the circumferential tongue portions are formed on a conical surface.

Another object of the invention is to provide an assembly of at least two parts interconnected by a screw-thread, between which parts there is placed a lock washer such as that defined hereinbefore, one of the two parts comprising, on the face thereof facing the washer, recesses which cooperate with the ends of the circumferential tongue portions which constitute catches, the other part having a flat face which extends axially and cooperates with the tab of the washer.

According to another feature, the tab extends through an intermediate part which is clamped between the two parts to be assembled. The intermediate part is formed by a washer which comprises notches in which penetrate, without extending therebeyond, the bent tabs of the lock washer and a boss which cooperates with the flat face formed on one of the parts to be assembled.

The invention will be described in more detail hereinafter with reference to the accompanying drawings which are given solely by way of example and in which:

Figure 1 shows a locking or stopping device according to the invention applied to an assembly between a rack and a ball and socket joint case for a steering device;

Figure 2 is a sectional view taken on line 2—2 of Figure 1;

Figure 3 is a detail view of the cooperation between a tongue portion and a recess;

Figure 4 is a view of an intermediate thrust washer;

Figure 5 is a view of a lock washer before bending;

5 Figure 6 is an axial sectional view of the lock washer of Figure 5 after bending;

Figure 7 is a sectional view taken on line 7—7 of Figure 6;

Figure 8 is a view of an intermediate washer, 10 and

Figure 9 is a view of an assembly of the lock washer of Figures 5 to 7 and the intermediate washer of Figure 8.

Figure 1 shows a rack 1 at the end of which is 15 screwed a ball and socket joint case 2, a thrust washer 9 being interposed between these two parts.

A lock or stop washer 10 arranged in accordance with the invention has for function to 20 prevent the untightening of this screwed assembly. This lock washer is placed between the thrust washer 3 and the end face 4 of the case 2. It has a tab 11 which is bent at roughly at right angle relative to the main plane of the washer 25 toward the rack which comprises, for cooperation with this tab, a flat face 5 or any other recess performing the same function. To permit the passage of this tab, the thrust washer also has a recess 6 (Figure 4). The lock washer further 30 comprises, in at least a part of its periphery, a plurality of tongue portions 12 which are generally oriented in the circumferential direction and are produced by cutting the washer, on one hand along an arc of a circle 13 centered on the 35 axis of the washer, and, on the other hand, along straight segments 14 which are oriented substantially radially or slightly obliquely relative to a radial direction, as shown in the drawing. The tongue portions 12 progressively extend away 40 from the plane of the washer and project from the face of the washer which faces the ball joint case 2 at a height which roughly corresponds to their thickness. This progressive deformation is important in order to avoid in use stress 45 concentrations which would occur if the tongue portion were merely bent.

For the purpose of cooperating with these tongue portions, the ball joint case 2 has a plurality of recesses 7 which define faces 8 50 against which the ends 14 of the tongue portions can bear. These faces 8 are so oriented as to be roughly parallel to the end faces of the tongue portions.

Preferably, the tongue portions 12 are spaced 55 equal distances apart, as are the recesses 7, but the pitch of the tongue portions and recesses is not the same. Preferably, the number of tongue portions 12 and recesses 7 on a circumference are prime numbers therebetween so as to ensure 60 that, within the tolerance limits of the torque applied to the case, at least one of the tongue portions freely projects into one of the recesses (Figure 2).

The lock washer 20 shown in Figure 6 65 comprises circumferential tongue portions 21

which are arranged on the whole of its periphery and two bent tabs 22 which extend from the edge of the centre orifice 23.

70 The tongue portions 21 are bent along a generally conical surface from which they progressively extend so as to project from this surface.

The bent tabs 22 are slightly divergent relative to each other in a direction away from the general 75 plane of the washer.

Such a washer is obtained from a blanked sheet as shown in Figure 5 which is bent, the bending bringing the base 21<sup>a</sup> of the tongue 80 portions onto a frustum of a cone the apex angle of which is about 60° and progressively separating the ends 21<sup>b</sup> of these tongue portions from the conical surface (Figure 2). Further, the two tabs 22 are also bent so as to have the shape shown in Figure 6.

85 In the application of this washer to the locking of a ball and socket joint case on a steering rack, as shown in Figure 1, this washer is used in combination with a thrust washer 24 (Figure 8). The latter has a centre orifice 25 and two notches 90 26 in which the tabs 22 engage without extending therebeyond. The washer 24 is maintained on the lock washer 20 by an elastic gripping action of the tabs 22 against the ends of the notches 26.

95 Also formed on the washer 24 is a boss 27 which has a rectilinear edge 28 adapted to cooperate with the flat face of the steering rack or other part which is a part of the assembly.

Further, the surface of the ball and socket joint 100 case, or other part on which the recesses are formed for cooperation with the tongue portions 21, has a conical shape which corresponds to the conical surface along which the tongue portions 21 are folded.

105 The advantages of a lock washer according to the invention are mainly the following:

there is no bruising as in the case of washers of mild steel sheet; there is no danger of fracture upon tightening;

110 it is unnecessary to bend the tongue portions manually to achieve the locking or stopping action and the lock washer is mounted in the same way as a normal washer;

as the tongue portions are subjected to a 115 compressive force under good conditions and are consequently much less fragile, the untightening torque which can be ensured is very high; the precision of the locked positions is satisfactory.

120 Moreover, in the case of the embodiment shown in Figures 5 to 9:

as the tongue portions are arranged throughout the circumference, their number is greater, which reduces the magnitude of the 125 angle between two positions of immobilization of the ball and socket joint case;

the lock washer has a greater strength and the tabs 22 are perfectly retained by their edge in the notches 26 of the thrust washer 24, the latter 130 being prevented from rotating relative to the rack

very well owing to the action of its boss 27;  
the lock washer 20 and the thrust washer 24  
constitute an assembly which is easy to place in  
position;

- 5 the tongue portions 21 are not blocked  
between the ball and socket joint case and the  
washer 24, so that they retain all their elasticity.

#### Claims

1. A lock washer comprising tongue portions a  
10 part of which projects from at least one face of  
the washer, wherein the parts projecting from a  
face of the washer are defined by substantially  
radial free edges of a plurality of circumferential  
tongue portions which extend progressively away  
15 from the plane of the washer and at least one tab,  
which is bent at roughly a right angle and projects  
from the opposite face of the washer, is provided.
2. A lock washer as claimed in claim 1,  
wherein the or each bent tab extends from the  
20 edge of the centre orifice of the washer.
3. A lock washer as claimed in claim 1,  
comprising two tabs which are disposed  
symmetrically relative to the centre of the washer.
4. A lock washer as claimed in claim 3,  
25 wherein the two tabs are divergent in a direction  
away from the surface of the washer.
5. A lock washer as claimed in claim 4,  
associated with an intermediate member  
comprising recesses in which elastically engage  
30 or clip the tabs whereby the two members are  
interconnected.
6. A lock washer as claimed in claim 1,  
wherein the free end of the tongue portions  
projects from the plane of the washer a height  
35 which is roughly equal to the thickness of the  
washer.
7. A lock washer as claimed in any one of the  
claims 1 to 6, wherein the tongue portions  
extend round a part of the circumference of the  
40 washer, and the or each bent tab occupies  
another part of this circumference.
8. A lock washer as claimed in any one of the  
claims 1 to 6, wherein the circumferential tongue  
portions are arranged on the whole of the  
45 periphery of the washer.
9. A lock washer as claimed in claim 1,  
wherein the circumferential tongue portions are  
formed on a conical surface.
10. A lock washer, substantially as

50 hereinbefore described with reference to and as  
shown in Figures 1 to 3 of the accompanying  
drawings.

11. A lock washer, substantially as  
hereinbefore described with reference to and as  
55 shown in Figures 5 to 9 of the accompanying  
drawings.

12. An assembly of at least two members  
interconnected by a screwthread, between which  
members there is placed a lock washer according  
60 to any one of the claims 1 to 11, wherein one of  
the two members has on the face thereof facing  
the washer recesses which cooperate with the  
ends of the circumferential tongue portions which  
form catches, the other member having a flat face  
65 which extends axially and cooperates with the tab  
of the washer.

13. An assembly as claimed in claim 12,  
wherein the recesses have abutment faces which  
are roughly parallel to the end faces of the tongue  
70 portions.

14. An assembly as claimed in claim 12 or 13,  
wherein the tongue portions are spaced equal  
distances apart and the recesses are also equal  
distances apart, but the pitch of the tongue  
75 portions and recesses is not the same.

15. An assembly as claimed in claim 12, 13 or  
14, wherein the numbers of tongue portions and  
recesses on a circumference are prime numbers  
therebetween.

16. An assembly as claimed in claim 12,  
wherein the tab extends through an intermediate  
member which is clamped between the two  
members to be assembled.

17. An assembly as claimed in claim 16,  
85 wherein the intermediate member is formed by a  
washer which comprises notches in which  
penetrate, without extending therebeyond, the  
bent tabs of the lock washer and a boss which  
cooperates with the flat face formed on one of the  
90 members to be assembled.

18. An assembly as claimed in claim 12,  
wherein the member in which are formed the  
recesses which cooperate with the tongue  
portions has a conical shape which corresponds  
95 to the conical surface on which the tongue  
portions are folded.

19. An assembly, substantially as hereinbefore  
described with reference to and as shown in  
Figures 1, 2 and 3 of the accompanying drawings.